1997
Executive Research Project

The Joint Stars Platform Decision

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INTRODUCTION

"I cannot deliver the aircraft, General!" With these words, Col. Robert Chedister, System Program Director (SPD) for the Joint STARS Joint Program Office (JPO), after consulting with Air Combat Command (ACC) [1], notified BG Ber Reiter, the Program Executive Officer that the Joint STARS program was unexecutable.

Since March of 1996, the System Program Director, in concert with the Special Management Office for Joint STARS (SMO -J) at HQ ACC, had been developing the budget for FY 98 Program Objectives Memorandum (POM). Due to funding cuts and cost increases (many associated with the Joint STARS airborne platform re-manufactured used Boeing 707 aircraft), the SPD notified the Program Executive Officer (PEO) and the Secretary of the Air Force for Acquisition (SAF/AQ) that the directed program was unexecutable as funded. He went on to advise them that the planned production profile and schedule would have to be restructured. He simply could not deliver the systems on the promised schedule[2].

As a result, a series of briefings were brought to the Pentagon to explain the problem, describe how it happened and plan a program restructure. As directed by both Air Force and Department of Defense policy, the appropriate Program Breach notice was prepared and a revised Acquisition Program Baseline document was submitted.

Because a major cost and schedule driver was the re-manufacture of the used Boeing 707 aircraft, no fewer than 11 reviews were undertaken to evaluate the cost and schedule baseline for that portion of the program. These studies focused primarily on the Northrop Grumman Lake Charles, Louisiana site, where the re-manufacture of the used Boeing 707 aircraft was performed.

Later in the year, in August of 1996, Air Combat Command accepted the first production E8-C (the military designation for the modified and refurbished Joint STARS production aircraft) from Air Force Material Command. This delivery signified the completion of a Full-Scale Development (FSD) program that had been initiated with a competitive FSD contract award in September of 1985.

Less than 48 hours after the formal acceptance ceremony, the System Program Director contacted the 93 ACW commander with the news that the JPO had discovered some discrepancies in the rivets used in the re-manufacture of the production E-8C aircraft. He suggested that the production aircraft not be flown until the Program office and Northrop Grumman could complete their analysis. Naturally, he informed the PEO and the Secretary of the Air Force for Acquisition (SAF/AQ) as well.

In the midst of this controversy, and now, almost irrevocably committed to proceed with the program, the Assistant Secretary of the Air Force for Acquisition, Mr. Art Money asked the SPD, "Do you think the decision to base the Joint STARS system on used aircraft was a good idea?"

The purpose of this case study is to analyze some of the decisions that were made during the development program that lead the Air Force to place its premiere airborne surveillance radar capability on a 30 year old airframe. Every attempt has been made to capture the decision making scenarios as they were understood at the time to confront the reader with the same uncertainties as those confronting the decision makers 5 to 10 years earlier (1985-1990). To the extent practical, this case study provides the same financial data, schedule data, and technical information that was available to the SPD(s) for Joint STARS. Where that is not feasible, the best approximations will be provided.

BACKGROUND AND HISTORY

In the 1968 the Department of Defense Deputy Director for Research and Engineering (DDR&E) issued a memorandum to the Assistant Secretary of the Army for Research and Development regarding the fielding of a helicopter-mounted radar for rapid, continuous, and broad area surveillance of moving ground targets. In June 1973, DDR&E directed a study of possible Standoff Radar Surveillance Systems that could detect large-scale movement of enemy forces in the event of hostilities in Europe[3]. The Army program to accomplish this was called the Standoff Target Acquisition System (SOTAS).

In May 1973, the Undersecretary of Defense for Research Development and Engineering (USDR&E) tasked the Air Force to develop a weapon system that would detect, locate and strike mobile enemy armor. This program was named PAVE MOVER. The Defense Advanced Research Projects Agency (DARPA) directed and funded the Air Force to develop a weapon system and to conduct end-to-end technology demonstration of the radar and missiles. The resulting Assault Breaker demonstrations were managed out of Rome Air Development Center (RADC) as advance development contracts.

These service unique requirements became the Joint Surveillance Target Attack Radar System (Joint STARS) requirement in May of 1982. USDR&E issued a memorandum directing that a Joint Air Force / Army Program Management Office be established under Air Force lead to develop a single multi-mode target acquisition and weapon guidance system[4]. As a result of this direction, the Joint STARS Joint Program Office (JPO) was established out of the independent Air Force PAVE MOVER and Army SOTAS program offices.

For the next two years, the Army's Training and Doctrine Command (TRADOC) and Air Force's Air Combat Command (ACC) would struggle to reach an agreement on the requirements of the Joint program that would satisfy the respective services. Candidate aircraft platforms included TR-1s, OV-1Ds and C-18s (military designation for the Boeing 707 in its commercial configuration)[5]. Acquisition strategies were developed and staffed with numerous changes required in the coordination process. Funding positions were established and tentative schedules were outlined. Between 1982 and 1984 the Acquisition Plan for the program was formally issued, amended twice and coordinated[6].

The initial Acquisition Plan required the development of a single, identical radar system to be hosted on three platforms--the Army OV-1D and the Air Force C-18 or TR-1. The first Amendment to the Acquisition Plan was driven by congressional direction. This amended program plan also required a single identical radar design for the airborne platforms. It went on to allow radar integration on the OV-1D and TR-1 with options for radar installation on the C-18. In accordance with congressional direction, however, radar installation on the C-18 would not be permitted without congressional approval (only operator consoles were authorized on the C-18.)

In May of 1984, the platform debate ended. The decision was finalized when the Army and Air Force Chiefs of Staff agreed to development of the airborne segment of the Joint Program using the C-18 as the sole airborne platform for both services needs[7]. With the Joint agreement reached[8] congressional opposition to the C-18 abated. In August of 1984, the second Amendment to the Acquisition Plan, reflecting the joint platform decision, was issued.

On 27 September 1985, after a lengthy and complex competitive source selection (4 revisions to the Request For Proposal (RFP) and 4 revisions to the proposals), with funds about

to expire, Grumman Aerospace Corporation was awarded the FSD contract to develop the airborne segment of Joint STARS. During the source selection, for affordability reasons and to meet budget constraints, Congressional and Air Force actions reduced the development platform quantity to 2 vice 4 aircraft. In what would prove to have significant impact on the program for years to come, the development program schedule remained unchanged. The contract retained options for a 3rd and 4th aircraft should funding and congressional concerns permit it.

The Acquisition Schedule

The Joint STARS program was based on a very aggressive schedule. In trying to leverage off the successful Pave Mover and Assault Breaker efforts, the joint program effectively skipped the Dem/Val phase and went straight from Concept Exploration to Full Scale Development. Two contract phases were initially planned to develop acquire Joint STARS. First was the Full Scale Development (FSD) program, referred to in the Decision Coordinating Paper as Block 1, included four aircraft systems (reduced to two during the source selection) supporting development and testing. The Production Phase (possibly a Low Rate Initial Production) would follow to generate the initial procurement requirement and incorporate additional user[9] requirements not funded in the basic FSD program. These enhancements were called Block 2. Pending more definitive requirements planning, the Office of the Secretary of Defense (OSD) supported an initial force structure of ten production systems. This force structure would include eight production systems plus the two development systems, which were to be refurbished to the production configuration after the completion of the development and test program.

The Program Milestones established after contract award included:

• Milestone IIA	Sep 85
• Radar/Aircraft/FSD Award	Sep 85
• Hardware PDR	May 86
• Software PDR	Mar 87
• Hardware CDR	Dec 86
• Software CDR	Aug 87
• Milestone IIB	Jun 87[10]
• DTE Start	Nov 88
• Production Award	Aug 90
• First Production Delivery	Aug 91
• IOC	TBD[11]
• Last Delivery	Sep 94

THE CONTRACT

With the award Fixed Price Incentive Contract on 27 September 1985 for $657 million, Grumman became the Joint STARS prime contractor. Because Grumman bid Target Price equal to Ceiling Price in the Best and Final Offer (BAFO), the resulting contract was effectively Firm Fixed Price (FFP). The contract for the design, fabrication, integration and test of the FSD system called for a 60-month period of performance. With an FSD award in 1985, it was expected that a production decision could be made in 1990.

Among the significant FSD contract deliverables were:

- Two contractor furnished C-18 aircraft, with options for a 3rd and 4th
- Airborne and Ground Data Processing
- Secure Anti-Jam Voice and Data Communications
- Software Development Facility
- Software Support Facility
- Weapon Interface Units (for fighter aircraft)
- Data Links
- Logistics and Training
- Ground Station Modules (Separate Contract-Army Developed)

Grumman Acquisition Strategy

Grumman's contract strategy had themselves as system integrator and principal software designer[12]. With a team of 11 subcontractors, Grumman's challenge was to effectively integrate a technologically challenging, state of the art "System of Systems" in an asset poor development program. This was to be done under a very aggressive schedule on a firm fixed price contract. With most fabrication and assembly work being done at geographically separate areas under Firm Fixed Price (FFP) subcontracts, Grumman's subcontract management would be vital to the program's success.

The original Grumman Team of subcontractors is shown below. In the course of the development program, Motorola and Raytheon would replace Aydin and Rolm.

• Boeing	707-300 Modification and Refurbishment
• Aydin	Display Generators
• Carrol Touch	Programmable Touch Displays
• CDC	Radar Programmable Signal Processor
• Hartman	Display Terminal
• Litton	Inertial Measurement Group
• Magnavox	UHF Radios
• Miltope	Printers
• Norden	Radar Sensor
• Rolm	Central Data Processors
• Telephonics	Intercom System

The 1985 contract was a typical "what to do and how to do it" contract. The Basic System Specification (A Spec) contained over 2000 "shalls" and referred to or directed dozens of Military Specifications and Standards. Because the government wished to emphasize "fly-fix-fly" as a development strategy, the contract milestone schedule mandated delivery and integration of the system by 30 months after award, with 30 months of development and operational testing to follow in support of the 1990 production decision.

The original contract schedule is summarized below. MAC indicates months after contract award.

	Date	MAC
Contract Award	Sep 85	-
System Design Review	Nov 85	2
Hardware Preliminary Design Review	May 86	8
Hardware Critical Design Review	Nov 86	14
1st Airworthiness Flight	Dec 86	15
1st System Flight Early Engineering Flight Test	Mar 88	30
Start System Level Performance Verification	July 89	34
1st C-18 deploys to WPAFB Field Test Demo	Oct 89	49
1st Unit DD-250 (Govt. Acceptance)	Sep 90	60
2nd Unit DD-250	Oct 90	61

Early Risk Assessment

The government expected the biggest challenges to be in the design and development of the radar components, the data link, and the system software, estimated at 200,000 source lines of code (SLOC). Because Boeing, the original manufacturer of the 707 airframe, was a subcontractor to Grumman, government technical personnel believed that the aircraft modification and refurbishment would constitute little cost or schedule risk. The JPO believed the riskiest technical elements of the program were the development of the Norden sensor and the software integration. Consequently, a great deal of emphasis was placed on the development of the sensor, data link and software. There was high confidence in the legendary performance of

Boeing and its ability to manage the 707 modification and refurbishment issues. No one knew 707s like Boeing.

The Boeing 707[13]

The era of modern air jet travel was ushered in on the wings of the Boeing 707. With its roots in the prototype "Dash 80," the Boeing 707 became the international standard for commercial aviation for most of the 60's and 70's. With a production line than began in 1960, 1010 commercial and military variant 707 aircraft of all types would ultimately be delivered.

Commercial history was made Oct 26, 1958 when Pan American World Airways inaugurated trans-Atlantic 707 jet service between New York and Paris; jetliners then rapidly entered service throughout the world. The first commercial 707 labeled the 707-120 series, had a larger cabin and other improvements compared to the prototype Dash 80. But with Pratt & Whitney turbojet engines, its range was barely sufficient for the Atlantic Ocean. A number of variants were developed for special use, including shorter-bodied airplanes and the 720 series, which was lighter and faster with better runway performance.

Boeing quickly developed the larger 707-320 Intercontinental series with a longer fuselage, bigger wing and higher-powered engines. With these improvements, which allowed increased fuel capacity from 13,478 gallons to more than 21,000 gallons, the 707 had truly intercontinental range of nearly 5,000 miles.

Early in the 1960s, the Pratt and Whitney JT3D turbofan engines were fitted to provide lower fuel consumption, reduce noise and further increase range to nearly 7,000 miles.

With its 4-engine configuration and robust design margins (No Federal Aviation Agency

(FAA) life limit), the 707 was a natural choice for military applications. Boeing built 820 KC/C-135 tanker-transport/cargo aircraft based on the 707 for the Strategic Air Command. Three 707-120s and two 707-320Bs, designated VC-137s, were delivered to Military Aircraft Command for transporting high government officials.

More recent military applications of the 707 are the E-3 AWACS (used by the US Air Force, NATO, The Saudi government, and French and British Air Forces) and the E-6 used by the US Navy for submarine communications 336 Boeing 707-300Cs were built between 1963 and 1974. With anticipated sales of the E-3 AWACS system to the British, French and Japanese, and E-6A TACAMO aircraft to the US Navy, 707 production was estimated to continue into the mid 90s[14]. Because of its unique configuration, the 707-300C intercontinental aircraft were the 707s of choice for the Joint STARS application.

707 Contract Requirements

There were three basic subcontract requirements for the 707, which the Statement of Work (SOW) defined as a 707-300C. The used aircraft had to be purchased, refurbished, and modified to the Joint STARS configuration. Boeing Military Aircraft Company (BMAC) accomplished this. Grumman would accomplish the installation and integration of the prime mission equipment. Because of the weight of the mission equipment, Grumman selected the cargo version of the 707 with its reinforced flooring as the baseline Joint STARS system. All cargo versions of the 707 were in the 300C series.

Purchase

The first two aircraft selected for Joint stars were a 707-338C and a 707-323C. Both aircraft were manufactured in 1968 and carried Boeing serial numbers 19626 and 19574 respectively. Aircraft 1 had 51,647 flying hours and 20,474 cycles (takeoff and landings). The much less weary Aircraft 2 had 40,008 hours and 17,191 cycles. These aircraft were selected based on availability, configuration, price and condition as well as the availability of FAA certification. Because these were privately owned aircraft, only limited inspections were possible prior to purchase. In order to limit the amount of wear and tear on any aircraft inducted into the Joint STARS fleet the target limitations on the number of hours and cycles on any candidate aircraft were set at 50,000 and 20,000 respectively.

Refurbishment and Modification / Militarization[15]

Refurbishment activities included de-painting the aircraft (removing the paint), performing corrosion control and repainting the aircraft. Incorporation of Airworthiness Directives (AD) and FAA Life Extension Service Bulletins was also required.

Service bulletins were issued by the original equipment manufacturer of the product to provide customers with data related to aircraft life, aircraft maintenance, inspections etc. Unless supported by an AD, performance of service bulletins were not mandatory. The FAA issued FAA Airworthiness Directives when an unsafe condition existed in a product or was expected to exist in a similar product. AD incorporation was mandatory. The SOW listed 21 service bulletins and the conditions under which they had to be completed. In addition, 64 add-on

Service Bulletins had to be performed on the aircraft. Treatment of corrosion was required, as was the replacement of rubber components, glass, hydraulic components etc. Cockpit and cabin furnishings were also overhauled and replaced, as necessary, with militarized equipment.

The last phase in the aircraft job was the actual physical modification and integration of the mission equipment onto the airframe. This effort included wiring modifications, lay down of a palletized cargo floor and other structural changes.

Growing Concerns

As Colonel Jack Colligan, the System Program Director, prepared the Program Office for its Milestone IIB Defense Acquisition Board[16], he needed to solve several requirements, technical, schedule and cost issues. The three major requirements related issues were Force Structure, Survivability and Block II requirements.

The Secretary of Defense Decision Memorandum (SDDM)[17] for Milestone I had directed the program to return with Block II requirements defined. Having worked that issue hard with ACC in preparing the budget, Colligan was comfortable that the Block II Upgrades (Flight Simulator, Mission Simulator, Self Defense Suite, and Readiness Improvements) he was bringing to the DAB would satisfy the most urgent of the unfunded user needs. He was also comfortable with the results of the Joint Statement of Operational Requirements Document (JSORD) force structure review. ACC and TRADOC were going to the Joint Requirements Oversight Council (JROC) for a force structure of 22 Joint STARS systems. Colligan was comfortable the JROC would support it.

The questions that had surfaced at Milestone IIA relative to operational suitability and system survivability would once again have to be addressed. The Army-led Operational Utility Evaluation (OUE) had concluded that Joint STARS was not only survivable but also the only system capable of meeting the joint requirements.

On the technical and schedule side there was a mix of both positive and negative news. By late 1987, while significant technical progress had been made in signal processing and prototype software, the frailty of the aggressive schedule and the asset limitations associated with only two development systems (vice the four really required) were becoming evident. Overall, the program cost performance was disappointing. Even though the Fixed Price contract protected the government from an overrun, with negative cost variances approaching $150 million and negative schedule variances exceeding $90 million[18], there was sure to be a debate with the Cost Analysis Improvement Group (CAIG) over the adequacy of the current and future estimated costs to complete the program, the likelihood of loss driven claims against the government, and the financial ability of Grumman and its' team to sustain a significant loss.

Unexpected Problems

Not only had the known technical risk areas, such as radar (10 month slip), software and data link development (12 month slip) displayed significant schedule slips, the "lower risk" aircraft modification and refurbishment was slipping as well.

Greater than expected corrosion, parts shortages, and aircraft unique configuration differences had combined, along with a Grumman / Boeing cooling system design dispute, to

delay first aircraft delivery by seven months and second aircraft delivery by nine months. (This would eventually lead to a $120M claim against Grumman by Boeing and Grumman counterclaim). The major contributors to the schedule slips were the inconsistent design baselines, aircraft condition and organic support considerations.

Used aircraft availability was also becoming a major concern. It was not clear that adequate used airframes would be available to support the proposed increased force structure. At the time of contract award, 336 Boeing 707-300C aircraft had been delivered to government and commercial users worldwide. With the advent of quieter engines, noise restrictions and the aging of the 707 fleet (production on 300Cs ended in 1974), availability of adequate aircraft to meet the directed requirement for 10 systems was not expected to be a problem. Many operators, most of them overseas, rather than re-engine or install hush kits and face increasing maintenance costs, were expected to retire the aging 707 aircraft and replace them with newer, quieter and more fuel-efficient aircraft. By the mid 80's Boeing's backlog seemed to reflect this. Boeing's firm backlog for jet transport aircraft had grown from $24 billion in 1985 to over $53 billion in 1988[19].

Unfortunately, 707 availability was declining on the used market. A program office study prepared with Grumman and Boeing tracked the estimated availability of used 707 Aircraft from 1983 through 1987. In the three years since the DAB IIA, estimates for "suitable" available aircraft dropped from 176 units to 43 units worldwide.

With the increase in force structure (soon to be 22, if the JROC prevailed) and the emerging lessons learned from FSD Aircraft 1 and FSD Aircraft 2, the Program Office and ACC undertook an evaluation of alternate platform solutions. This study would be used to solicit OSD

support for making the recently approved third aircraft (an additional test aircraft was authorized by Congress in the 1988 Appropriation) a "production representative" article on a new (factory fresh) platform, possibly a new 707 variant.

For these reasons, the Air Force and Grumman began to consider alternatives to the used platform solution. In early 1987, a joint JPO / Grumman study was undertaken to evaluate new candidate aircraft suitable for Joint STARS.

The overall funding situation was workable. With congressional support for a third test asset and a DAB schedule that complemented the FY 90 POM, the DAB review could be used to gain both financial and program support for a new aircraft. There had been few changes to the FFP baseline. Consequently, there was some margin in the budget. More importantly, the program office was blessed with a charismatic and gifted financial team in program control. Colligan was sure they could structure an affordable near term program, and push the bills to the outyears so that the POM build could balance the funds.

The largest remaining issue was the platform selection. Colligan knew that the operators supported a new airframe. He also knew that there was growing interest in a NATO or Cooperative Joint STARS. A lot of agendas and a lot of interested parties would be looking over his shoulder on this one. He would have to convince ACC, TRADOC and the DAB principals that he had selected the right airframe.

The Platform Study[20]

The Program Office initiated a comprehensive Alternate Platform Study in December 1986. This study was conducted in two phases. An initial study was prepared to support the planned June 87 DAB Milestone IIB. When the DAB was slipped to April 1988, a Platform Extension Study was undertaken. By April of 1988, when the DAB was held, the program office had evaluated 15 candidate aircraft systems. Because development of a new airframe would be both cost and schedule prohibitive, the candidates were limited to those that were either in the inventory or currently in production. The study considered both domestic and foreign aircraft suppliers.

Since the Block II requirements were going to add weight and power demands on the system, the study had to address not only the baseline technical requirements of the system, but the expanded requirements to be validated by the JROC and the DAB IIB.

Production Joint STARS aircraft would have to take-off from a 10,000-ft. runway, with over 37,000 lbs. of mission equipment. The aircraft would need to operate at an altitude between 34,000 and 42,000 feet and achieve a mission time of 11 hours (20 hours refueled) at an over ground speed of 450 knots. They would have to accommodate 15 consoles and a mission crew of 34. Based on the current design (Hardware PDR would be held in April 1988), sufficient ground clearance to mount the Joint STARS radar beneath the aircraft was required. The system would be required to provide 270 kVA power with one engine out. Adequate power and cooling would be required to accommodate the expected Block II configuration.

The study evaluated these variables for 15 different aircraft types and concluded that several aircraft types, in addition to the 707, would satisfy the Joint STARS requirements[21]. The matrix below is an abstract which summarizes the results of the initial platform study. The platforms that met the Joint STARS technical requirements were the Boeing E-6, the Boeing 767-200, the Boeing 747SP, the Boeing 747-200, the McDonnell Douglas DC-10-30, the McDonnell Douglas MD-11, the Airbus A-310-300 and the Airbus A-340-200. Colligan knew he would need to study the acquisition and operating and support costs before making a decision as to which platform to recommend.

Cost Estimates

With the technical comparisons completed, an initial budgetary estimate was required to evaluate the Life Cycle cost sensitivities associated with each candidate. Like the technical analysis described in the Preliminary Study, the cost analysis had to include not only the current program and contract content; it also needed to consider the Block II requirements from the Joint Statement Of Operational Requirements Document (JSORD). A comparative budgetary estimate was completed. The estimates are summarized below. As the data shows, the cost drivers and discriminators were principally those associated with the nonrecurring design of the system (First Aircraft Cost), the recurring costs of the airframes. Because the E-6 variant was of the same 707 family as the baseline designed Joint STARS, it's first aircraft cost estimate was significantly less than those for a platform requiring complete redesign. The bottom line of the study (given in Base Year $ without fee) was that an additional $491 million would result in a new E-6 based fleet of 20 aircraft. If the aircraft were available, Colligan had his answer.

MOIA-271

JOINT STARS PLATFORM STUDY
PRELIMINARY REPORT RESULTS SUMMARY

Candidate Aircraft	Avail	Non Mission / Refueled Time, HRS		Mission Time 11 Hrs	Altitude 37.6 k lbs. PME	(1000 Ft) 50.0 k lbs. PME	Ground Clearance (in)	Militar ized	Total Floor Space ($FT^{2)}$	Total Volume (FT3)	Takeoff 1000 Hot Day (PME Payload 37600 lbs.)	Distance FT Condition (PME Payload 5000 lbs.)
		PME Payload of 37.6K lbs.	PME Payload of 50.0K lbs.	PME Payload (1000 lbs.)	34	34	48.2					
707-300	1990	11.0	9.6	37.6	34.8	34.8	48	Partial	1,296	8,203	11,500	11,500
MD-87 UHB	1992+	NAC	NAC	NAC	34.0	34.0	36	Partial	758	5,618	NAC	NAC
757-200	1990	8.7	8.0	NAC	35.4	35.4	81	NO	1,542	9,925	8,200	8,200
A310-300	1990	11.5	11.0	50.0	35.2	34.3	74	NO	1,927	11,228	7,200	7,900
707/CFM56	1990	12.6	11.0	NR	NR	NR	48	NR	1,286	8,203	NR	NR
707/V2500	1990	14.8	12.9	NR	NR	NR	48	NR	1,296	8,203	NR	NR
E-6	1990	13.9	12.6	66.0	36.8	36.4	48	YES	1,296	8,203	8,100	8,100
A300-600R	1990	8.5	8.2	NAC	33.0	32.0	74	NO	2,352	16,385	7,300	8,100
767-200	1990	14.5	14.1	82.0	37.6	36.8	77	NO	2,144	16,937	6,700	7,200
A340-200	1992	20.2	19.3	117.0	34.5	34.0	74	NO	2,844	20,895	7,700	8,100
C-17A	1992+	9.6	9.4	10.0	36.4	35.8	25	YES	1,550	20,900	7,000	7,500
DC-10-30	1990	13.3	13.0	85.0	34.7	34.1	88	Partial	3,197	25,001	10,000	11,500
MD-11	1990+	18.4	17.7	150.0	35.7	35.1	88	NO	3,729	29,475	7,800	8,100
747SP	1990	17.1	16.5	122.0	37.3	36.9	81	Partial	3,993	27,410	5,900	6,200
747-200	1990	16.7	16.2	204.0	36.6	36.3	87	Partial	5,486	37,345	6,000	6,300

NAC - NOT ACHIEVABLE
NR - NOT RECEIVED

JOINT STARS JSOR FLEET COSTS
$ M FY 83 FOR 20 AIRCRAFT
WITHOUT FEE

	707-300C	A310 -300	E-6 Variant	767 -200	A340 -200	DC-10 -30	MD-11	747SP	747 -200	CURRENT 707
FIRST AIRCRAFT (A/C)	277	297	159	299	318	270	322	287	306	68
A/C PRODUCTION ACQUISITION (2-20 A/C)	1,336	2,574	1,399	2,627	3,176	1,991	3,211	3,047	3,417	932
A/C SUBTOTAL	1,613	2,871	1,599	2,926	3,494	2,261	3,533	3,333	3,723	1,001
GROUP B PME & OTHER COSTS	1,214	1,214	1,214	1,214	1,214	1,214	1,214	1,214	1,214	966
SIGNIFICANT O&S (FUEL)*	1,360	832	1,045	945	1,225	1,666	1,429	1,997	2,213	1,360**
TOTAL FLEET	4,187	4,917	3,818	5,085	5,933	5,141	6,176	6,544	7,150	3,327

NOTE: THESE NUMBERS ARE A ROUGH ORDER OF MAGNITUDE (ROM)

NORMALIZATION FACTOR FY86 TO FY83 DOLLARS = 1.149

* THE COST DELTAS FOR THE REMAINDER OF THE 0&S COSTS IS ASSUMED SMALL ENOUGH SUCH THAT THESE COSTS WILL NOT BE CONSIDERED HERE

** FUEL COSTS WERE ASSUMED TO BE THE SAME AS THE JSOR VERSION

New 707 Availability.

Given its mid sixties pedigree, it was surprising to some that 707 aircraft were still being produced. There was interest not only in completing the Navy E-6 TACAMO program (based on a 707 variant), but there was Japanese interest in purchasing E-3 Airborne Warning and Control Systems (AWACS), also a 707 based system. The overall market also included French and British AWACS systems. The planned deliveries of the 707 family are shown in the Table below[22].

	1986	1987	1988	1989	1990	1991	1992
Saudi	5	8					
Navy E-6				4	4	4	4
British						4	3
French						3	1
Japanese (Not Firm)					3	4	4

Because of the schedules associated with operational testing of Joint STARS, it would be necessary to take delivery by late1990. This was earlier than a new start would allow. The nominal cycle time was three years. Even with a favorable DAB decision in April 1988, the contracting cycle and the lead time would combine for a delivery no earlier than 1992, a full two years late to the directed schedule.

The E-6 aircraft were being manufactured by Boeing Commercial Systems (BCS) in Seattle. The Navy E-6 TACAMO system was being managed and contracted for out of Naval Electronics Systems Center (NAVELEX). After extensive discussions between Navy and Air Force flag officers, a tentative plan was developed to divert one of the in-line TACAMO E-6 (serial number 10) aircraft to Joint STARS. This aircraft's scheduled delivery (Nov 90) would support testing in 1991. That would be enough to protect the Joint STARS schedule and get the fleet into newer aircraft. The Navy would accept a later unit consistent with their schedule and an available airframe that Boeing had yet to sell.

A series of planning meetings were held with Boeing and JPO personnel to solidify the baseline planning for an E-6 based Joint STARS fleet. Because Boeing hoped to maintain the 707 as the Command, Control, Communication and Intelligence (C3I) platform of the future, they were eager to help the Air Force structure the program[23].

DAB IIB

The SDDM from DAB IIA established a requirement for a DAB Milestone IIB Program Review to be held in January 1988. The principle driver for the review was to evaluate overall program progress and to consider the results of an Operational Utility Evaluation. Some members of the acquisition community were very concerned with the operational utility of the baseline configuration. This was really fueled by a concern over survivability and the Joint STARS operational concept, which had the system operating within the reach of certain known threats. The date established in the SDDM was slipped to April 1988 to allow for completion of the Operational Utility Evaluation. All the DAB requirements for documentation (Test and

Evaluation Master Plan (TEMP), Decision Coordinating Paper (DCP), Integrated Program Summary (IPS), Independent Cost Analysis (ICA) etc) and the accompanying briefing trail were undertaken. By the time all of the documentation had been worked and reworked and all of the briefings concluded, the Air Force and OSD had validated the survivability and the operational utility of the system.

The SPD requested 5 decisions from the DAB. The program office brought a decision set to the DAB which requested schedule relief, new 707 authorization (based on inline modification to the existing E-6 TACAMO production line); increased fleet size from 10 to 22 production systems; incorporation of critical user requirements not funded at the previous DAB (or in subsequent Presidents Budgets[24]) and an additional test aircraft. The JPO had been able to structure the program financially, so that no additional funds were required in the POM years. All additional funds were needed in fiscal years 1994 and out.

Citing the cost, schedule, availability and risks associated with continued reliance on the used 707 aircraft, as well as the benefits of the more capable new E-6[25], the Air Force proposed hosting the Joint Stars mission equipment on a variant of the Navy TACAMO platform as the best technical and most cost effective solution for the long term. The E-6 TACAMO aircraft, when modified for Joint STARS would be designated the E-8B.

On 18 April the DAB was held. The Acquisition Decision Memorandum (ADM)[26] was received on 5 July 1988. The ADM authorized the continuation of FSD as requested. The requested schedule relief, additional test asset and Block II program were approved. The approval included"...an increase in the force structure from 10 to 22 aircraft; (and) a change in the airborne-platform to a new 707 aircraft using the E-3/E-6 TACAMO production line. In all, the

ADM provided favorable direction on each of the five decisions requested. Unknown to the DAB, the JPO or the Air Force, in the time between the DAB and the publication of the ADM, a break in 707 production line, to include the E-6, began.

Executing the DAB Decision

With the receipt of the ADM, the JPO was able to move out in earnest on the third aircraft acquisition. Because the DAB support was predicated upon schedule risk abatement[27], the JPO was compelled to execute the contract actions necessary to field this production representative system prior to the scheduled operational testing.

Major contracting efforts to be accomplished included acquisition plan approval and issuance of a stop work order on those elements of the contract associated with the used 707 that would not be continued or needed with a new aircraft. This eliminated effort would come to be known as the "Core Stop Work". A contract modification was needed to place the new aircraft effort on the existing contract with Grumman. Modifications to the in process E-6 would be contractually implemented by NAVELEX via supplemental agreement to their existing production contract with Boeing. Because approval had been expected, efforts were already underway, with Grumman preparing a proposal and a Navy /Air Force Memorandum of Agreement (MOA) complete.

The plan ran into trouble almost immediately. Because the initial acquisition plan had included a third and fourth aircraft, as priced options, it was believed that the existing acquisition plan was adequate for the intended modifications for the E-6. Legal review officials disagreed. A new Acquisition Plan modification was directed to include changes to the Determination and

Findings (D&F). During that review process, the contract type also became a source of controversy. Where the SPO and the contractor favored FPIF on the existing contract, higher headquarters reviewers pressed for a cost plus vehicle and a separate contract. Eventually, the JPO position would hold. This unanticipated use of contracting support would however place additional strain on the JPO's resources and the schedule[28].

The Block II Upgrade project was similarly challenged. When the JPO, Grumman and ACC got into the details of the proposed upgrades, it was clear that there were serious differences in expectations over funding, technical performance and schedule. From a JPO perspective, unabated requirements creep was threatening the program, since the ACC requirements included items from the JSORD that were not included or supported by the DAB. ACC believed all critical JSORD requirements were still valid and included in Block II. Grumman's position was that they were going to insist on adequate cost and schedule to perform any new work[29].

Detailed discussions were also underway with Boeing and Grumman on the scope and complexity of the modifications necessary to convert the E-6 unit into a Joint STARS E-8C. There was general agreement on the cost of the basic airframe ($ 77 million). As with the Block II Upgrade, it quickly became apparent that the expectations of Boeing, Grumman, and the JPO were significantly disconnected here as well. Major requirements of the in-line modification included:

- No degradation to Electromagnetic Pulse Hardening
- Upgraded cockpit avionics
    - Integrated control and display units
    - Third Inertial Navigation Unit

- VOR/ILS Receiver
- New Flight Management Systems

- New Avionics Requirements
  - Extensive Bit In Test (BIT)
- System Level Electromagnetic Interference and Compatibility
  - Full Mil-SPEC requirements
- Environmental Control System Upgrades
- Interior improvements for crash worthiness and lighting
- Increased reliability and maintainability
- Logistic Support Analysis and Maintenance planning

The JPO assessed this as a low-cost ($ 20 million) moderately complex modification effort (18 months). After initially agreeing with this assessment, Boeing came to believe that the technical complexity associated with the inline modification was more extensive than originally thought. In a series of Rough Order of Magnitude (ROM's) estimates developed between June and December 1988, Boeing estimated the costs of the in-line modification at $178 to $266 million—two to four times the cost of the aircraft itself! Consequently, a great debate ensued over the complexity and scope of the modification effort

Neither Grumman nor the JPO believed that Boeing's revised estimate for the modification was credible. Both believed that this was merely part of the "classic Boeing" approach to sole source contracting, and that more reasonable costs would eventually be established as they worked through what would undoubtedly be a tough negotiation process. In fact, there were some high level assurances from Boeing that a deal agreeable to all could be

reached[30].

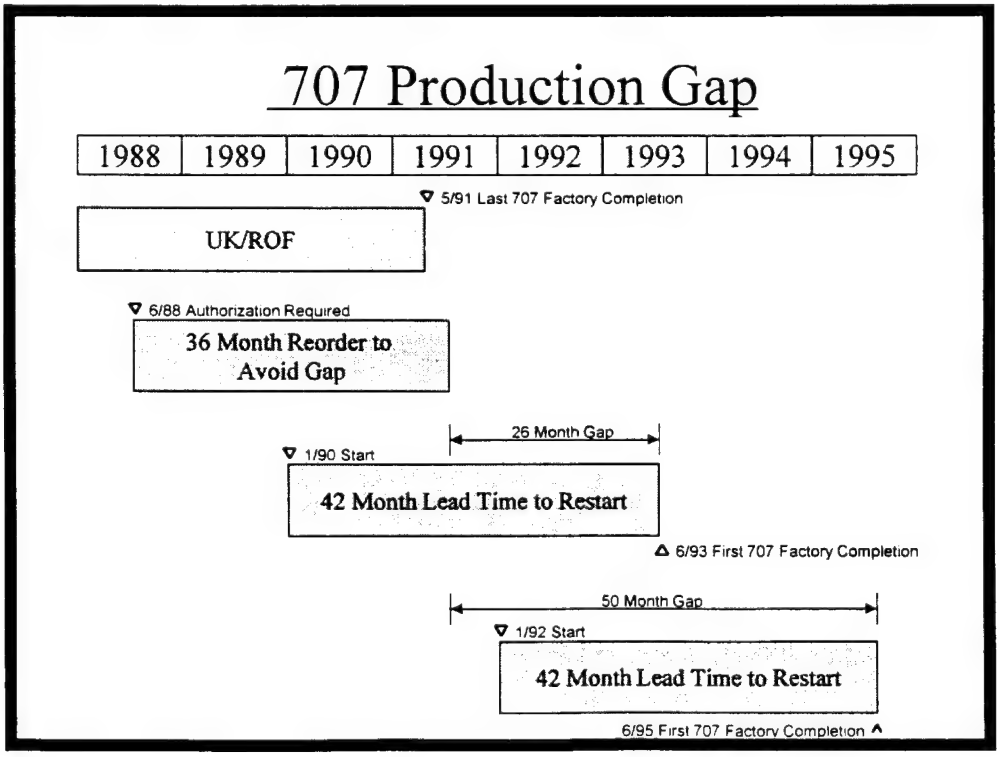
A series of detailed technical reviews was undertaken to scrub the requirements and the numbers. By November 1988, only $ 13 million of cost and requirements had been deleted from the modification ROM. Boeing was standing very firm on its cost position. By April of 1989 Boeing had developed an FFP position. They would perform the job for $355 million. It would take three years and result in a late CY 93 delivery. This was two full years later than the DAB approved schedule.

Since the government could not afford the Boeing in-line modification price tag, the JPO and Grumman developed alternate strategies for either a modification subcontractor, or Grumman to perform the necessary modifications after delivery. After several months of evaluation it was decided that Boeing was not interested in providing an affordable E-8B modification. It was also determined, based on discussions with several mod houses, that Grumman or another mod house could complete a retrofit modification after delivery at a significant cost and schedule savings vice the Boeing price. This effort was scoped at approximately 12 months with a range of estimates of $50 million to $150 million. Grumman was willing to perform the modification for $ 77 million under a Firm Fixed Price contract.

Taken together, neither the Block II definition nor the alternate modification solution, would cause a program breach. Neither would cause a cost or schedule impact to a critical milestone that would break an approved threshold. The Boeing in-line modification schedule had threatened the milestones. The alternate source solution had proven a successful workaround to that, and more affordable

The largest shock to the plan came at the June 1989 Grumman/JPO Executive Management Review, where Grumman announced that, according to Boeing, a 707 production break had matured into a full fledged line shut down. Without an immediate contract action to secure long lead parts for the Joint STARS production aircraft, Boeing was going to close the 707 production line. The back shops had already started to close. If this were true, there would be an Acquisition Program Baseline breach!

Both the Program Director and the Grumman VP for Programs, Mr. Martin E. Dandridge, went to Boeing in search of facts and solutions to the problem. In spite of all of the pre DAB coordination, they found there was indeed a break in the line. According to Boeing, since neither the Japanese AWACS nor Joint STARS programs (which had always forecasted an FY 90 start) had come forward with firm orders/cash in a timely manner, a break in the 707 line started in June 1988[31].



Boeing agreed to continue to "support" the program. They committed to develop some alternative strategies and cost estimates. They wished to support not only Joint STARS, but also the still expected Japanese AWACS in spite of the break in production. Colligan and Dandridge believed that the backlog for 737s and Boeing's intention to increase the 737 production rate from 17 aircraft/ month to over 20 aircraft/month were creating such a demand for the Seattle factory space, that Boeing was no longer willing to have the low rate 707 occupy that shop space without firm commitments, if at all.

The Recovery Campaign

The JPO was fighting an acquisition battle on three fronts -- the Block II enhancements, the modification to the E-6, and continuity of baseline airframe production. All battles were being fought on a sole source contract battlefield. Without a strong, credible corrective action plan, with contractor and ACC, the DAB program was at risk. An over-arching issue was the fact that the timing of these issues had seriously damaged the Grumman/JPO business relationship.

There were assertions that industry had knowingly let the Air Force go to the DAB with a broken program. Since neither the prime contractor, nor his principal subcontractor had communicated to the program office the impending break in the 707 line, until after the DAB, there were some serious hard feelings and alleged integrity issues to be worked. These too would have to be overcome.

Throughout the balance of 1988, the JPO would continue to work the ACC disconnects and the modification cost issues. Joint ACC, contractor and JPO teams were formed to work out the affordability and the priority of the JSORD requirements. If the requirements scrubs did not yield an affordable set of requirements for Block II, at least they would provide a prioritized list of shortfalls.

New acquisition strategies evolved. By early 1989 Colligan knew he needed help with the production break. He elevated the issues. He advised the SAE via monthly reports of "cost and schedule problems." In addition he solicited support from both the Electronic Systems Center (ESC) and Air Force Material Command (AFMC)[32] commanders to help with the Boeing "production break." In response to this general officer interest, and the eventual completion of cost estimates previously requested, Boeing provided their final production gap analysis

Given the lack of 707 orders from either the Japanese or Joint STARS programs, the production space in Seattle was being converted to 737 production. Boeing did offer to relocate the 707 line to Wichita to the Boeing Military Airplane Company (BMAC) facility, if the government was willing to pay the expense.

According to Boeing's analysis, the cost of the line break was now a function of the length of the gap and the cost of the relocation/restart of the line[33]. Assuming an FY 90 restart, Boeing estimated the nonrecurring cost to relocate the facility and design the in-line modification at approximately $539 million (FY 90 Dollars). They also estimated a recurring unit cost penalty of $ 70 million per aircraft. This would drive the recurring unit airframe cost from $74 million to over $ 140 million per unit. All told, the 707 line relocation would cost the program almost $ 1.0 billion in

unanticipated costs. Boeing believed these costs could be partially offset by optimizing the Japanese and Joint STARS buys. They went on to suggest a multiyear buyout as the most cost effective and affordable strategy[34].

Colligan now knew he had a non-recoverable cost and schedule breach to the baseline DAB program. In July 1989, the Joint Program Office declared an Acquisition Program Baseline Breach.

The Program Restructure

When an Acquisition Program Baseline Breach occurs on a major program, a number of administrative and review mechanisms are activated. Principal among them is a revisit with the Defense Acquisition leadership in the Defense Acquisition Board forum. Unlike a Milestone Review, which is scheduled for years, a breach based review happens very quickly.

The responsibility for this review fell to Col. Harry Heimple. Heimple assumed the Program Director position in August of 1989 following the retirement of Col. Colligan[35]. Since he served with Colligan as Deputy System Program Director for Joint STARS, he was very familiar with the program and the issues. Heimple knew that the first month of his tenure would be spent explaining the basis for the breach and the corrective actions taken. That would be quickly followed with the need to restructure Joint STARS into an executable program.

The biggest single issue facing the program was clearly finding an affordable platform. While the E-6 still had strong technical support, Boeing's pricing left it too expensive. The platform study would have to be revisited with the view toward finding an alternate platform. With the strong support of Grumman, Heimple restarted his technical folks in evaluating

candidate platforms. In addition to those previously reviewed, the JPO was to evaluate the KC-135, KC-135R, MD-87 UHB, Boeing 757-200, Airbus A300-600R, Boeing 767-300, C-141B, and the C-17A. In all, 16 different platforms would have to be evaluated very quickly. The first briefing was scheduled for 7 September with SAF/AQ. Mr. Jack Welch, the Air Force Senior Acquisition Executive (SAE), would take the briefing. Having worked for Mr Welch previously, Heimple was comfortable in his ability to build a program that would pass muster.

The 1989 Platform Study[36].

As with the earlier studies, radar performance on a given platform would be the critical criteria in platform selection. Any aircraft that could not physically support the radar configuration was eliminated. Some aircraft lacked adequate power, or ground clearance or flight stability characteristics necessary to be seriously considered. Some candidates exhibited radar beam blockage as a function of engine nacelle placement. Any major structural design issues generally led to disqualification of the candidate. There were really only a handful of serious candidates to be considered: the Boeing E-6, the McDonnell Douglas MD-11, the used 707-300, the Airbus A340-300and the Boeing 767-300ER. Given the affordability of the E-6, and the concerns with the used 707, the analysis focused on, the 767, A340 and the MD-11.

767-300ER

The 767-300ER would require dropping the radome further below the fuselage to meet the baseline radar requirements. This had dramatic affect on the aerodynamic qualities and the stability and control of the twin engine 767. In order to compensate for the stability and control

degradation caused by the Joint STARS radar installation: a major structural modification to the tail of the 767 would be required. The situation worsened in the event of a wet runway and engine out condition. Analysis indicated that the aircraft would fall out of the FAA certified baseline envelope, requiring yet additional structural and control system modifications. The electrical and environmental control systems would also require major redesign to accommodate the Joint STARS mission equipment.

The Airbus A340-300

Initially, the A340-300 was thought to have sufficient control margin to handle the forward location of the Joint STARS radar antenna without any projected changes. As the study progressed, a joint Grumman and Airbus consortium study identified a potential stability and control problem for the A340-300, similar to that of the 767-300ER. Major modifications to the electrical and environmental control systems would also be required. Logistically, there was no existing organic government support for the Airbus. A logistics and sustainment tail would have to be developed.

McDonnell Douglas MD-11

The MD-11 was an attractive candidate. While it too would require moving the antenna further down the fuselage, it possessed adequate control margin. The MD-11 was also the only aircraft that could meet the electrical and environmental control system requirements without a major change to the existing aircraft design. Based on its commonality with the DC-10-30 and the Air Force KC-10, systems that had been modified to meet the KC-10 requirements could be directly

incorporated into the Joint STARS MD-11 variant.

Heimple knew he had to get a handle on the costs as well as the technical baseline for the restructured program. He was hopeful that he could find an affordable "new" aircraft for the program. As he was preparing for the DAB review, he received tasking to include both the baseline E-6 directed program, and a used 707 alternative in the options he was developing. . Heimple really hoped to avoid a "used" aircraft solution

The Road to the DAB

While preliminary briefings were developed and presented to Mr. Welch and his staff, alternatives were added, modified and deleted as cost and technical information matured. By the time Heimple and his briefing reached the Air Force Council, the cost and schedule alternatives addressed included the E-6 directed program, the MD-11, and the 707-320 used aircraft. A number of variations around these platforms were developed with different acquisition strategies considered to minimize the costs. For example, cost estimates for multi-year procurement strategies were developed; mixed procurements of new and used aircraft were considered. Retrofit and in-line modification concepts were developed. Summary data for the final alternatives follows in Table 1. Even though only three platforms were seriously considered,differences in the acquisition strategies generated 6 different options.

Table 1 - Joint STARS Program Options
E-6 Multi Year Procurement- Grumman Retrofit Modification
E-6 Minimum Production- Grumman Retrofit Modification
E-8A (Used 707)
E-8A / MD-11 Used for IOC, MD-11 Replacement to Follow
MD-11 Multi-Year Procurement
MD-11 Normal Procurement

Each of these options was distinguished not only by the aircraft platform they employed, but also by the schedule the JPO could execute. Assuming a DAB Milestone III Production decision in FY 92, a series of Annual Buy profiles with resulting Initial Operational Capability (IOC) dates was developed for each option. These are summarized in Table 2.

The Annual Buy schedules were principally driven by estimated funding requirements. Table 3 provides the complete fiscal year requirements to execute each respective options. The data shown is the combined net requirement for both Development (3600 Funds) and Procurement (3010 Funds). Excess funds are shown as nominal values; shortfalls are enclosed in parenthesis.

As the Table 3 and Table 4 data shows, the used 707 was the most affordable platform option. It was also the most attractive from a schedule perspective in that it provided the earliest Initial Operational Capability date. The old concerns with the used aircraft, that had driven the decision for the E-6 still existed. Corrosion, condition, availability and life cycle costs were very much on the minds of ACC, SAF/AQ, and the DAB. Very hard looks were being taken to try and save a new platform.

Table 2 - Joint STARS Options

Schedule Comparison

	Buy Profile	FY*	IOC
E-6 MY	4,6,6,4	92	4Q 97
E-6 Min	3,3,4,4,3,3	92	4Q 97
E-8A Used	1,1,2,4,4,4,4	92	1Q 97
E-8A/MD-11	1,1,2,2	92	4Q 97
(6 used 20 new)	2,2,2,4,4,6	94	N/A
MD-11 MY	2,2,6,6,4	92	3Q 97
MD-11 Normal	1,1,2,4,4,4,4	92	4Q 97

- Indicates First Year of Production Program

Table 3 - Option Summary- Total Costs (Million of Dollars)

	FY 90	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	TC	Total
E-6 MYear	55	258	1287	1590	1374	1040			6414
E-6 Normal	55	393	1350	1311	1364	1383	1004	950	7821
707 Used	25	195	437	412	552	840	779	1544	4785
Used New	32	175	390	510	615	987	657	4867	8235
MD-11 Normal	14	141	426	627	555	826	1248	3785	7732
MD-11 MYear	14	226	290	504	485	765	1280	3290	6856

Table 4 - Option Summary- Budget Comparison* (Million of Dollars)

	FY 90	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	TC	Total
E-6 MYear	10	(241)	(1025)	(1008)	(763)	(189)	502	916	(1799)
E-6 Normal	10	(376)	(1098)	(730)	(754)	(532)	(206)	478	(3207)
707 Used	40	(178)	(175)	169	59	11	20	(116)	(170)
Used New	33	(158)	(128)	71	(5)	(136)	141	(3438)	(3620)
MD-11 Normal	51	(124)	(264)	(46)	56	25	(450)	(2356)	(3108)
MD-11 MYear	51	(209)	(28)	77	125	86	(481)	(1861)	(2241)

- Parenthesis indicate shortfalls to approved program

The Case For New

Because it was widely held that a multi-year procurement would not gain congressional support or approval in a timely fashion, the focus turned to the traditional full funding, non-multi year acquisition approaches. The MD-11 normal procurement costs were not only less expensive than those for the E-6; the near term funding profile was a lot more attractive to the Air Force decision-makers and budgeters. The MD-11 also enjoyed the benefits of commonality with the KC-10 described above. Because it was more affordable than the E-6, and believed to be less of a logistics problem than the used 707, the MD-11 was the most attractive alternative to the used 707.

The JPO prepared the Table 5 data to summarize the differences in system availability parameters that could be expected as a result of hosting the Joint STARS radar on the used707 vice the MD-11. The MD-11 was clearly a more reliable platform.

Table 5 - Joint STARS Weapon System Availability

	Used 707	MD-11
Not Mission Capable (Maintenance)	9%	2.5%
Not Mission Capable (Supply)	8%	1.5%
Predicted Mission Capable Rate	80-85%	96%
Launch Reliability	94%	98%
Average % Possessed	92%	95%

In a further attempt to structure an affordable MD-11 Option, the JPO argued that this increased reliability and availability would have the net affect of reducing the fleet size requirements if the system were based on the MD-11. According to the JPO analysis, the inherent availability coupled with the benefits of the KC-10 logistics infrastructure, could result in an MD-11 based fleet requirement of 17 vice the 21 required for the less reliable used 707. A comparison of the Life Cycle Costs for 15, 25 and 35 years shows that a reduced force structure fleet (17 MD-11 aircraft) is more cost effective at the 25-year point and beyond than a used 707 based system with its higher fleet requirement. This is summarized below in Table 6.

Table 6 - Joint STARS Significant Life Cycle Cost Summary

	Used 707 (21 Aircraft)	MD-11 (17 Aircraft)
15 Years	$ 9,271	$ 9,792
25 Years	$ 12,610	$ 12,254
35 Years	$ 16,473	$15,248

The Decision[37]

In the end, the earlier Initial Operational Capability and near term budget issues combined to offset the advantages and life cycle cost savings associated with any of the new platform alternatives. Because the Air Force had already successfully integrated the system on used 707 aircraft, it was considered the lowest technical and schedule risk option. After considerable deliberation, the Air Force recommended that in order to reduce the program cost overrun and to preserve the schedule for the first European orbit capability in 1997, that the program be re-baselined using refurbished 707 aircraft. This recommendation was brought to the OSD staff where it was endorsed by the Conventional Systems Committee._ On 31 October 1989, the DAB reviewed the airborne portion of the Joint STARS program. In an Acquisition Decision Memorandum, dated 9 November1989, the Air Force recommendation was approved. The Joint STARS program was restructured to a used 707 platform. Today the Air Force employs used 707s as the baseline production aircraft for Joint STARS.

Epilogue

There have been, and there will continue to be issues associated with the Joint STARS 707 aircraft. Since the restructure in 1989 there have been times when operational systems were grounded due to aircraft related problems. The concerns over the cost and schedule of corrosion and refurbishment have continued. senior Air Force Material Command engineers have expressed concern over widespread fatigue damage in the 707 fleet. As the opening of this case suggests, it is not intuitively obvious to senior acquisition professionals that the used aircraft decision was correct. Time may yet tell.

What is obvious is that the Joint STARS system has saved American lives in combat. In 1991, in an unprecedented move from development to combat, the two used 707 based Joint STARS development systems deployed in support of Desert Shield and Desert Storm.

On 17 December 1990, the JPO ordered Grumman to prepare to deploy the two test aircraft to support the Persian Gulf operations. On 12 January 1991, the aircraft arrived in Saudi Arabia. Two days later Joint Stars flew its first operational mission. Joint STARS would go on to fly every day of the Gulf War. The system logged 535 hours with 49 combat sorties and a system availability in excess of 80%.

"On a particular January mission, the Joint STARS crew detected an Iraqi armored division's assembly area and a large vehicle convoy moving ominously towards Khafji." In one of the most dramatic examples of how battlefield intelligence coupled with responsive targeting and the lethality of strike airplanes transforms modern warfare, the Joint STARS crew vectored two A-10s and an AC-130 gunship into the convoy. Between them, the two Warthogs and the

AC-130 destroyed 58 of 71 vehicles[38,39]."

If user satisfaction is a figure of merit for the 90's, then the system has delivered on its promise.

"...We will not ever again want to fight without a Joint STARS kind of System. It is just terrific."—General Merrill A. McPeak, Chief of Staff USAF

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Selected Acquisition Report (RCS: DD-COMP (Q&A) 823) Program: Joint STARS As Of Date: December 31 1995

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Used Aircraft Production Plan for Joint STARS, 30 June 1990

ENDNOTES

[1] Formerly called Tactical Air Command (TAC).
[2] The author served in the Joint Program Office for Joint STARS from May 1986 through June 1997. In those cases where no documentation exists or was found, the author relied on his personal recollections of the events described. Where possible, other participants have been interviewed. Elements attributed to them will be cited below. The author assumes full responsibility for the accuracy of the case study
[3] Acquisition Plan
[4] Selected Acquisition Report (RCS: DD-Comp(QA)823) Program: Joint STARS
As of 31 December 1986 Page 2 para 7.a.
[5] In the initial stages of the program it was decided that existing platforms were the most cost effective near term solution to the Joint STARS platform requirement pending completion of the Full-Scale Development phase. A modular design requirement was established so that the production radar system to could easily be re-hosted on another platform. At this time, a final force structure decision had not been validated.
[6] Amendment 2 to Acquisition Plan No. TCG-83-1, 27 May 83
Program: Joint Surveillance Target Attack Radar System, 24 Aug 1984
[7] Department of the Army and Department of the Air Force Memorandum of Understanding, Joint Surveillance and Target Attack Radar System (Joint STARS), 11 May 1984
[8] One factor in this decision was the successful refurbishment of a commercial 707 aircraft into the C-18 Advance Range Instrumentation Aircraft (ARIA) by the 4950th Test Wing at WPAFB
[9] Tactical Air Commands Requirements directorate, ACC/DR would serve as the single user interface between Army and Air Force war fighters and the Joint Program Office (JPO). DR would set up a Special Management Office for Joint STARS called SMO-J
[10] Milestone IIB would later slip to April 1988 to accommodate the study of system survivability documented in the Operational Utility Evaluation
[11] Initial Operational Capability (IOC) was a classified date. At the time of Milestone IIA, the definition was pending
[12] Stephen G. Norton, From Concept to Combat,, Grumman Aerospace and Electronics, April 1994
[13] Internet Citation,: WWW.BAC.Com,Boeing
[14] Over 1000 707 aircraft would ultimately be produced.
[15] Van Weele, Alan, Joint STARS White Paper, 13 February 1995
[16] Formerly called the Defense Systems Acquisition Review Council (DAB);
[17] Memorandum For Secretary of the Army, Secretary of the Air Force, Subject: Joint Surveillance Target Attack Radar System: Milestone IIB Acquisition Decision Memorandum, 5 Jul 1988
[18] Selected Acquisition Report (RCS: DD Comp(Q&A)823)(U), Joint STARS AS of Date 31 Dec 1988)
[19] 1988 Boeing Annual Report
[15]Preliminary Report, Joint STARS Platform Study, Joint Program Office, FOUO, 9 June 1987
[21] Preliminary Report, Joint STARS Platform Study, Joint Program Office, FOUO, 9 June 1987
[22] Published sources did not specify annual delivery data. Totals and years were documented. Author interpolated annual deliveries from published data on totals, first and last deliveries.
[23] Interview: Col. Stephen H Farish, (USAF) Ret. then Deputy PM for Logistics, 2 April 1997
[24] The JPO had submitted annual initiatives to gain the additional funding for the deferred user requirements. These initiatives were not supported in the budget process.
[25] The E-6 baseline design included EMP protection and fuel efficient CFM-56 engines
[26] Memorandum For Secretary of the Army, Secretary of the Air Force, Subject: Joint Surveillance Target Attack Radar System: Milestone IIB Acquisition Decision Memorandum, 5 Jul 1988
[27] IBID
[28] In 1989, the JPO would receive policy direction from HQ USAF directing a cost plus contract for follow on development work
[29] Grumman and its subcontract team would eventually invest (lose) almost $300 million on the Joint STARS FSD

contract

[30] Interview with Col. Jack Colligan, USAF, Ret., 3 Apr 1997

[31] The break information was formally documented in a Boeing Briefing, Japan and Tanker Alternatives, October 1989

[32] Formerly Air Force Systems Command (AFSC)

[33] The break information was formally documented in a Boeing Briefing, Japan and Tanker Alternatives, October 1989

[34] The details of the Boeing cost position, were documented by the JPO in support of the DAB restructure

[35] Heimple was attending DSMC during the first half of 1989. He had been announced as the next SPD for the JTIDS program when he was reassigned by the SAE Mr Welch to the Joint STARS job.

[36] A. Van Weele, Memorandum, Joint STARS Alternative Aircraft, 9 March 1997

[37] Under Secretary of Defense, Memorandum for Secretary of The Air Force, Secretary of the Army; Subject: Acquisition Decision Memorandum for Joint STARS Program, 9 November 1989

[38] Reaching Globally, Reaching Powerfully: The United States Air Force in the Gulf War. September 1991

[39] Stephen G. Norton, From Concept to Combat,, Grumman Aerospace and Electronics, April 1994

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